

Evaluation of EPZ in case of severe accident of SMR

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Abstract

In response to the pressing need to combat climate change, the European Union has set the ambitious target of achieving carbon neutrality by 2050. While renewable energy sources are fundamental to this transition in the crucial energy sector, they are unlikely to suffice alone. Consequently, attention is increasingly turning to nuclear energy, particularly to Small Modular Reactors (SMRs).

The work presented here aligns with the European project SASPAM-SA, adopting its design and core inventory as reference for a generic iPWR based on the well-established and reliable Light Water Reactor (LWR) technology. From this data, the potential for reshaping the emergency planning zone (EPZ) for this new reactor type, thanks to their inherent safer features and the optimization of specific passive safety systems, has been analyzed.

Traditional EPZs are often overly conservative and lack adaptation to specific reactor designs. The aim of this study is to demonstrate the feasibility of scaled-down EPZs to support the development of SMRs in the coming years and enhance their public acceptance.

An analytical and conservative model has been developed to simulate the environmental release of radionuclides in the event of a severe accident and their subsequent atmospheric dispersion. The resulting environmental concentration is then used to perform a dose assessment in terms of EDE (Effective Dose Equivalent), CEDE (Committed Effective Dose Equivalent), and TEDE (Total Effective Dose Equivalent) within the first 24 hours after the release. The highest TEDE values obtained are compared with pre-defined reference levels. This allows for the redefinition of EPZs, which appear to be significantly smaller compared to traditional ones.

Furthermore, the analytical model has been validated using the software GENII FRAMES, yielding coherent results in terms of TEDE and EPZs' radii.

Finally, the analysis also includes some key elements concerning the transportation of irradiated fuel and the safety concerns due to a potential different localization of the power units.